

Getting to know

Performance Aero Engines

TEXT AND PHOTOS
BY WAYNE THOMAS

The PAE staff includes (left to right): Roger Kyle, machinist; Mark Robichand, shop foreman; Dave Wicks, general manager; Ginger Monson, outside sales; Ron Monson, president; Jennifer Scherer, accounting. (At large: Zago Demitrio, machinist.)



A

virtual oasis of tranquility among Los Angeles County's tangled trellis of Victor Airways and feeder airports, Brackett Field lies in the shadow of the San Gabriel Mountains, in the otherwise undistinguished hamlet of LaVerne, California (near Pomona). Although no more than a few *dozen* miles east of the heart of Los Angeles, Brackett Field seems far removed from the soot and cacophony of downtown L.A. Somehow, a century of suburban sprawl has managed to sidestep tiny Brackett Field. The smog is less oppressive there; the dew on the grass a little cleaner. On a sunny day, you can still see the future.

It seems only fitting, then, to find within the framework of Brackett's well laid out business park an *engine shop* that could be considered an oasis—of sorts—among

engine overhaul facilities. Performance Aero Engines. Moreover, when it comes to flat-opposed engines, Performance Aero Engines could very well qualify as one of the *most advanced* F.A.A. certified repair stations around.

The Right Stuff

Stepping into the main shop area of Performance Aero Engines, my first view of the place was jaw-dropping experience. Instead of the usual not-so-subtle *eau d'Varsol* and cochlea-piercing background noise that one comes to expect when visiting engine shops, I was greeted with spotless white floors (except for the skidmark left by my chin), lighting worthy of a movie set, and a virtually deafening silence—no

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noise, no foul odors, no cracked linoleum. Was I in the right place?

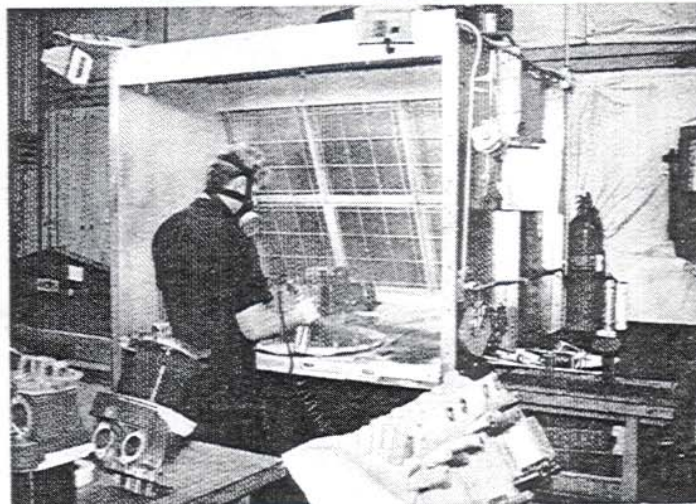
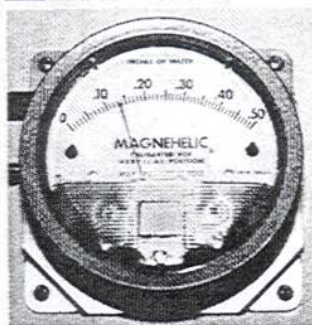
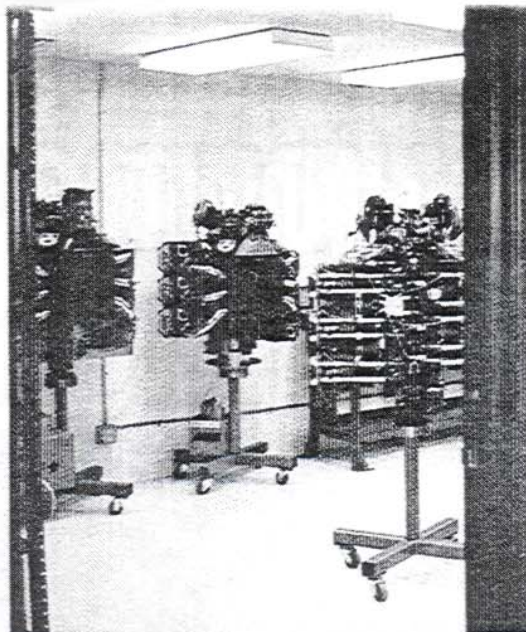
As I surveyed the tableau of modern, computerized machinery neatly installed along each wall, Performance Aero Engines' president, Ron Monson, came up to introduce himself and offer me a guided tour of the facility. It seemed I was in the right place after all.

I'm usually not a sucker for surface appearances, but Performance Aero's exceptionally clean, well-organized shop area, I must admit, did make a powerful and positive first impression. Perhaps tipped off by the lobotomous smile on my face, Ron assured me that I was not the only one to be impressed in this fashion. He said matter-of-factly, "Anybody who has ever visited my shop while shopping for an overhaul, has given me their business." A strong statement, but I can see why.

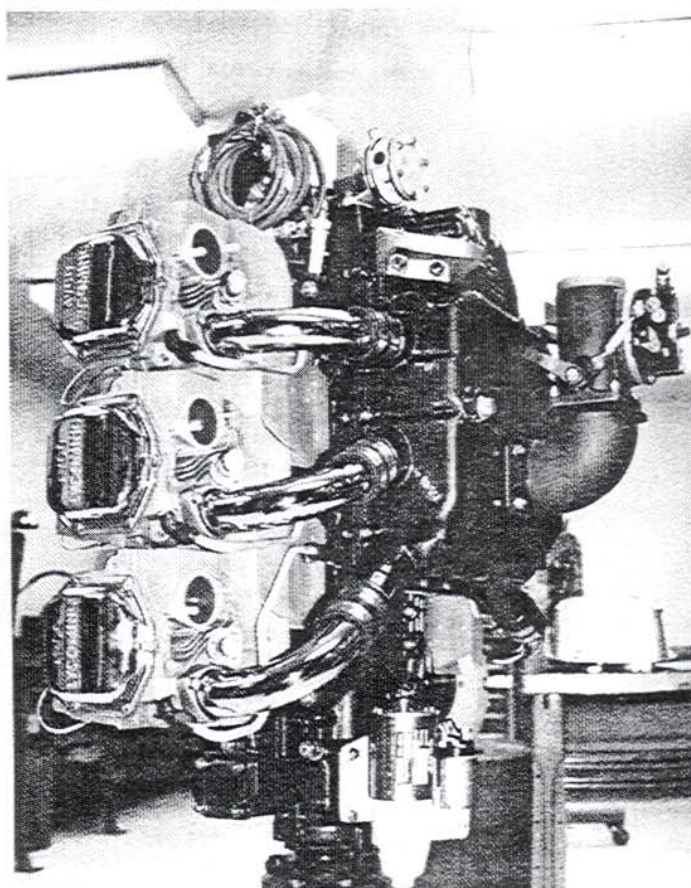
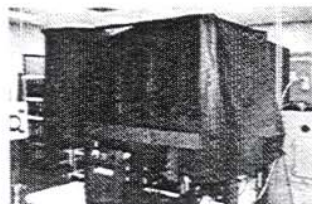
What They Do

To stay one-up on the competition and give customers the best value possible, Ron has equipped his shop with some of the most modern machinery money can buy, along with an experienced staff who knows how to make it all work. The result of this blending of tech with talent is an impressive list of processes and specialized tasks that Performance Aero performs in-house. Everything from align-boring to crank balancing to Zyglo and Magnaflux inspection are done within Performance Aero's facility. Even powder-coating (the same electrostatically applied powder that made Palo Alto's Victor Aviation famous) is done in-house, by the Performance Aero crew.

I examined several of PAE's recently completed engines and I must say that from a cosmetic standpoint they looked extremely sharp. The in-house paintwork and



PAE offers what may be the only genuine clean-room environment in piston aviation (at least, in the engine overhaul part of the business). Top photo shows one of the environmentally controlled, filtered-air rooms, with Magnehelic air pressure gauge (showing 0.135 in. Hg of pressure differential) on the wall to monitor room air pressure. At right: Painting and powder-coating are done in-house, with topnotch results. Ready-to-go customer engines look better than factory new. (Accessories like mags and starter ARE new.) Directly below: Even the Magnaflux booth is spotless.





Left: Final assembly takes place in a spotless, well-lit room.

powder coating are exceptional, giving a look far superior to a factory engine. (And if you know anything about powder coating, you know it's *tough*. You can't crack or flake the stuff off even with a sledgehammer.) My personal recommendation is to *go get yourself some cheap sunglasses* prior to picking up your engine from Ron Monson. These jewels really sparkle.

What really counts in the engine biz, though, is not the glitz but the guts. Anybody can build a "pretty" engine. The trick is to apply state-of-the-art technology to make it a precision-built masterpiece that will go the distance (to TBO and beyond). In this regard, perhaps one of the most technologically sophisticated tasks performed at Performance Aero Engines is spectrographic, two-plane dynamic balancing. This type of balancing can have a profound effect on engine smoothness and longevity, not to mention owner happiness (and owner longevity). But what is it, exactly? Ron gladly took the time to demonstrate to me exactly what spectrographic balancing is, and how it is accomplished.

Monson directed me to a large

piece of machinery that looked basically like a drill press with a CRT display screen growing out of its side. Ron began his introduction by saying, "This is our balancing machine—and this is a Lycoming 540-series crankshaft that's in here to be balanced." I watched and listened. Ron pointed his finger. "What we do is put all of the parts on the crankshaft that are going to be rotating with it, less the propeller. You can see the counterweights are in place, as are the pins and rollers, the flywheel and the adapters." He then pushed a button and started the crank spinning.

In brief, the spectrographic part refers to the CRT display that shows the crank's state of balance in the form of a circle with a floating, red dot in it. When the crankshaft is spun up, the red dot moves to a location within the circle, indicating precisely where to remove material from the crankshaft. A number is also displayed on the CRT screen indicating just *how much* metal to remove in order to achieve a balanced state. Actually, there are *two* of these circles on the screen, one for each axis of crankshaft balance, hence the term "dual-plane" or "two-

plane", balancing. (It wouldn't make sense, obviously, to try to compensate an imbalance on the *front* end of the crank by removing weight from the *back* end.)

Ron went on to explain to me that Performance Aero Engines pre-balances all pistons, piston pins, end caps, and connecting rods to within one gram. In addition, he said: "We balance all connecting rods for center-of-mass. We balance all counter weights for center-of-mass, as well as for total weight. This is necessary for the *dynamic balance* of an engine's rotating and reciprocating parts."

Not every shop is set up to perform dynamic balancing using the latest equipment, so it should come as no surprise that Performance Aero Engines does its balancing act for other shops, too. All of the procedures are approved under PAE's repair station license, and in case you're wondering, Ron Monson really *has* been in the business for years (previously, he worked for Magnum Engines in Ontario, CA), unlike certain "shaft balancing" experts who *advertise* years of experience, but either don't have the experience or got it outside of aviation. (Nelson comes to mind; see p. 3, this issue.)

Monson is also duly proud of his SuperFlow flow bench, which comes into play when flow-matching customer cylinders (more of which, in a minute). This is something you'll see at only a few aviation engine shops (Barrett Performance in Tulsa, for instance).

Both the balancing machine and the flow bench capture data for later printout, so the customer can go home with a graph of how his parts

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performed. Again, not something you see very much in aviation.

An Options Bonanza

I witnessed a wide range of engine types being worked on at Performance Aero Engines, including one Pratt & Whitney R-1340 waiting in the wings. Although there really aren't any engine types that Performance Aero *won't* work on, Ron did indicate a rather well defined edge to his typical customer and engine profile. "We're dealing to the Bonanza owners a lot, but the bulk of our engine overhaul work is for Experimental aircraft; Glasairs, RV-4s and the various fiberglass kit planes with pusher engines," Ron told me. He went on to add: "Probably 75% of what we do is high performance, Experimental work. We specialize in blueprinting and dynamic balancing, porting and polishing. Areas that are very unique in the industry."

Just to make sure, I asked Ron, "Are there any engines you *won't* work on, as a rule?" His reply: "Yeah, jet engines. We're FAA certified for powerplant one and two—but no turbine stuff." So basically, Performance Aero Engines performs the complete range of "by the book", certified overhauls. The *majority* of their work, however, is in the no-holds-barred Experimental category, where port massaging, lumpy cams, and other trickery would otherwise be a major *no-can-do*.

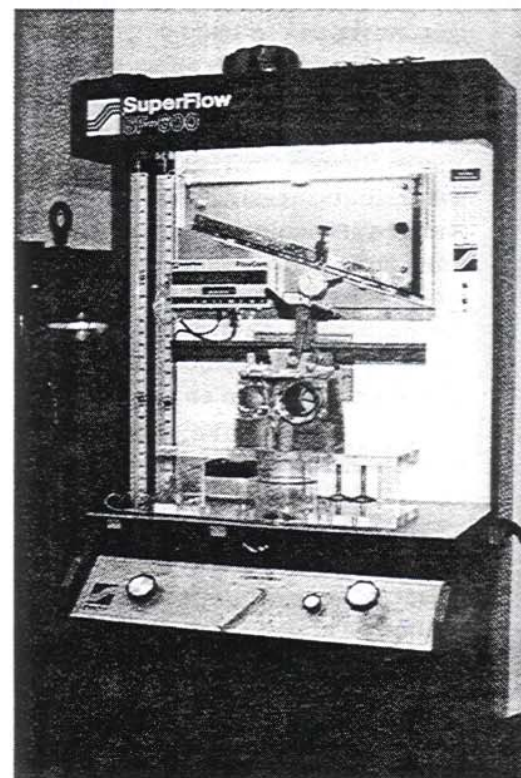
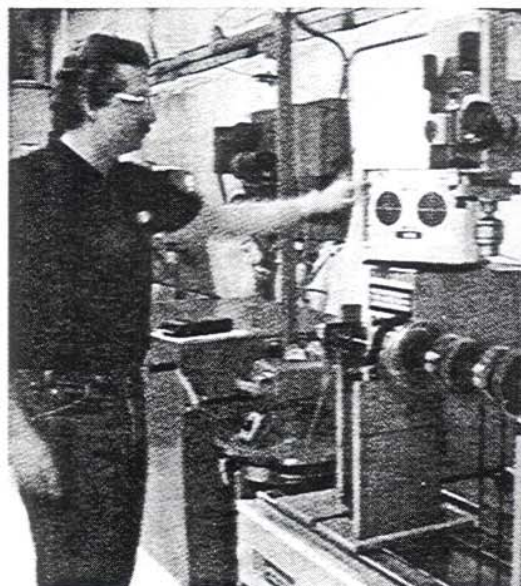
"The sky is the limit," Ron says, when it comes to the reworking of engines for Experimental use. No wonder 75% of Performance Aero Engines' business comes from the Experimental category. Where there's a *will*—and a *whole bunch of really cool special tooling on hand*—there's a way. Both are present at Performance Aero.

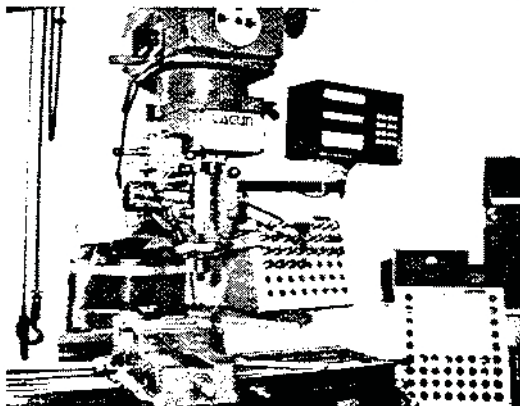
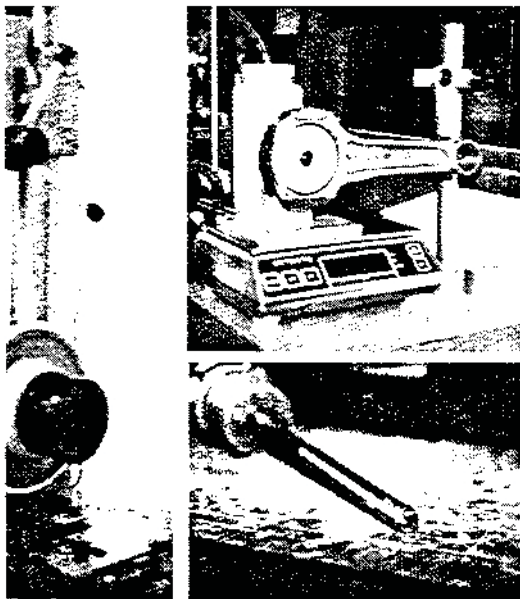
I asked Ron if porting wasn't really superfluous on an aircraft cylinder. "Well, when it comes to

porting an aircraft engine's cylinder head," Ron explained, "bigger is *not* better—unless you know what you're doing." Ron's basic rule of porting is to remove only as much material as needed to achieve the desired results. The desired result, according to Ron, is a modest but measurable improvement port flow characteristics at all valve lifts, and cylinders that *match*. Again, this is something he can and does document for each customer engine. The SuperFlow machine generates data that, when graphed, provides a clear visual picture of the cylinders' before-and-after flow characteristics at various valve lifts and air flow rates. Obviously, this kind of flow-tweaking cannot correct tuning or turbulent-flow problems caused by poor intake-pipe geometry. But according to Ron, every bit helps.

The computerized feature of Performance Aero's flow bench makes it a snap to achieve matching port-flows within each engine. The flow printouts are laid over one another for comparison. "We match each port's flow rate to within one cubic foot per minute," Ron says. "The bottom line is, this type of balance among each of an engine's cylinders can make a big difference in smoothness, horsepower, efficiency and overall engine reliability."

Special tooling—all of it handmade by Ron and staff using Performance Aero's host of on-site machinery—abounds. Ron demonstrated one piece of top-secret gadgetry that's used in conjunction with PAE's flow bench. From a trick Ron picked up back in his youthful auto-engine hotrodding days, he made what is basically a jury-rigged pitot-tube that connects to the flow bench. By moving the pitot tube attachment within a port's outbound flow, small areas of turbulence can be detected by the flow bench's computer. When these areas of





Top: PAE's back side faces out onto Brackett's ramp. Middle: Ron Monson demonstrates use of the spectrographic two-plane crank balancer. A significant factor in achieving good dynamic balance is to use matched connecting rods (middle right). At PAE, rods are big-end weighed as well as matched for total weight. The long tool in the picture under the rod photo is a valve-guide hone. Monson believes in honing (not reaming) guides to final ID, not only for accuracy but for proper wear-in (per Lycoming S.I. 1200). At far left: PAE uses a Spectroflow flow bench to monitor port efficiency. Immediate left: One of a series of consistent "porting" is to make a rubber mold of the port (that's the black thing). Finally the big machine is a Spanish-made taper milling machine with computerized table position readout (not to mention gear backlash errors), accurate to half a thou.

unwanted turbulence are eliminated, Ron says there's often a *significant increase* in the overall port-flow. This neat gadget is just one of many that get used every day within PAE.

Flow is also enhanced through custom valve grinds that often involve extra angles (or what some people call "back-cutting the valve"). At PAE you'll often see cylinders for Experimental engines that utilize three-angle and sometimes even *five-angle* valve jobs. All of this is to aid with flow.

To aid with *seating* and *wear*, all valves are hand-lapped to their seats, and concentricity gauges are used to ensure that valves, seats, and guides are concentric to within .001-inch.

In addition to multi-angle valve grinds, PAE offers high-compression pistons and a choice of exclusive (PAE-proprietary) cam profiles. According to Ron, he's more than happy to implement just about any type of mod that an Experimental customer might wish for, within reason.

Just Like NASA

Performance Aero Engines does all final engine and component buildup inside a "clean room" similar to what you're likely to find at Intel (only without the wild music). Standing next to a door sill, Ron describes how the system works. "Filtered and temperature-controlled air is pumped into the clean room with just enough pressure to keep unfiltered air from entering anywhere else, even through this open door." Turns out there's even a wall-

mounted gauge outside the room's doorway that displays the slight positive pressure maintained inside the clean room. Ron adds: "The *entire* shop area is also temperature-controlled. This helps to keep our machinery and precision measuring instruments in calibration." (No Kathie Lee sweat-shop, this.)

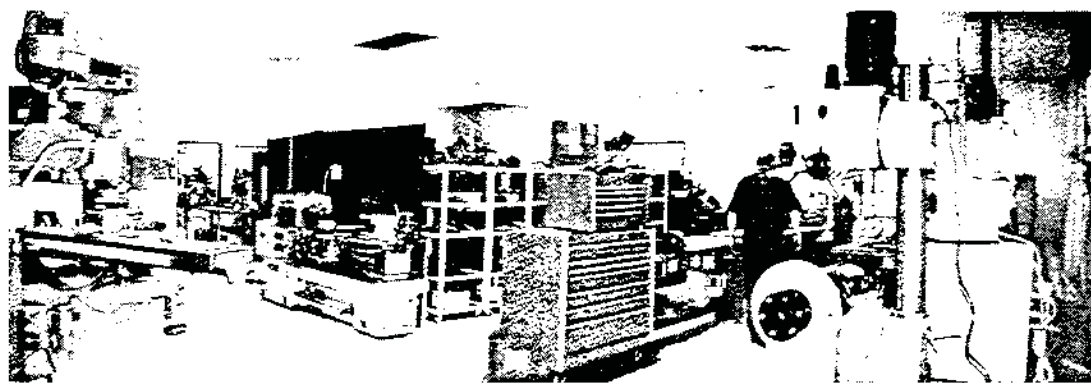
One such precision measuring device that Ron showed me looked a lot like a parking meter. "See these small increments on this gauge?" Ron said as he pointed to the parking meter's glass covered face. "These increments each represent *fiftymillionths* of an inch," he said. I looked up and said: "Whoa! Not much time left. Better drop in another quarter, don't you think?" Actually, what he was showing me was an extremely precise hole-size measuring instrument. "This particular piece of equipment," Ron added, "is a \$7,000 add-on for a much larger piece of equipment. NASA and aerospace subcontractors are about the only other places where you'll find gauging instruments like this."

Up and Coming

I was somewhat surprised to learn from Ron that Performance Aero Engines had been in business for just three years (since 1995). With the relatively large number of engines I saw in their shop (I counted about 40, altogether), along with the barrage of high-tech machinery present, three years simply seemed a tad too brief an amount of time for all this expertise to gather in one spot. Likewise for the number of overhauls that they do annually, about 100 according to Ron. I mean, how do you go from zero to 100 engine overhauls per year, in just three years time?

Ron was glad to set me straight by saying, "We've been here, at Brackett, for three years. I've been doing this type of work for *fifteen* years. Before I began this operation,

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Panoramic view of Performance Aero's main work space. (Total work space is about 4,000 square feet.) Modern equipment, clean work environment, long hours, and a policy of replacing old accessories with factory new or factory-rebuilt units (instead of rebuilding old cores on-site) makes it possible for seven people to do the work of fifteen or twenty.

generally, than engines run with a multi-vis oil."

Convincing testimony, if you ask me.

The R&R Minority

Despite the airport location, most engines arrive at Performance Aero Engines' big back door by truck. Still, Ron tells me, they're happy to perform the necessary R&I work when a customer requests it. With that in mind (along with the fact that I had not yet seen any sort of test bed on hand), I asked Ron how test run-ups are performed. "We don't have a test cell, yet," Ron admitted. "But we're working on one. It will be a state-of-the-art unit, with a computer-controlled dynamometer. We should have it up and running within the next six months." Judging by the other high-end equipment I saw in his shop, I'm sure the test cell will be very up to date, indeed.

"Okay, but still," I said, not ready to let go of the issue just yet, "how are engine run-ups handled in regard to those engines that are sent back to home base via truck?"

Monson replied: "Most engines that we ship back to our customers, if not all of them, are installed by an A&P, and we include a written break-in procedure with each engine that details the power settings, temperatures, and pressures to observe during break-in," Ron said. "If there's ever a question, either the plane's owner and/or the

A&P mechanic can always reach me by phone. This system has worked well for our customers."

It's actually a system that works well for about a third of all engine overhaul shops in the country. FAR Part 43 says that an overhaul's not an overhaul unless it includes testing per the manufacturer's recommended procedures, but the fact of the matter is, FAA has not enforced the issue. Probably because it's not clear that it needs strict enforcing.

In any event, this will be a moot point by the end of the year. By then, PAE will be set up with its own dyno.

Wants and Warranties

Reflecting the current standard of the industry, the warranty provided by Performance Aero Engines is on a par with the warranties provided

by Continental or Lycoming on *their* rebuilt engines. That is to say, the PAE warranty protects the owner against defects in materials or workmanship 100% for a period of one year, followed by pro-rata protection to TBO at a utilization rate of 40 hours per month. (*Note: This is actually better than Lycoming's warranty on overhauled engines, which ends after one year and has no pro-rata provision — Ed.*)

One of the few areas of the business of overhauling aircraft engines that Performance Aero Engines does not participate in is the overhaul of accessories. Instead, Ron tells me, they install *factory new* fuel injection systems and new slick magnetos on just about everything (unless the customer has a different preference). STC'd lightweight starters are another favored "install" among PAE and most of its customers.

Pricing is an area that Ron will be happy to go into at length for anybody who calls or faxes him. The shop's rates, while not cheap, are competitive with those of the better shops in the industry. For example, Monson said that PAE will overhaul a Lycoming IO-540-C (Aztec engine) for \$19,400, with new cylinders.

Performance Aero Engines FAA Certified Repair Station #P6FR393N, 1935 McKinley Avenue, Suite C, LaVerne, CA 91750. Phone (909) 593-5008, fax (909) 593-3774.

At a Glance:

Pros: Cleanest shop we've been to; modern equipment; good warranty; emphasis on new (rather than rebuilt) accessories; specialized services available. On-airport location.

Cons: No test cell or dyno (one is coming).

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